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Conodonts from the Keokuk, Warsaw, and Salem Formations (Mississippian) of Illinois

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CONODONTS FROM THE KEOKUK, WARSAW, AND SALEM FORMATIONS (MISSISSIPPIAN) OF ILLINOIS

Carl B. Rexroad and Charles Collinson

ABSTRACT

The Warsaw and Salem Formations in the Mississippi Valley area have produced a conodont fauna consisting of eleven genera and seventeen species, four of which are new. The fauna is relatively sparse and is numerically dominated by only two species, *Gnathodus texanus* and *Taphrognathus varians*.

Several sections of the Keokuk Formation yielded a fauna that is dominated by *Gnathodus texanus*. Otherwise the fauna is much like that of the Warsaw-Salem.

Differences in abundance of conodont species seem to indicate that the units can be biostratigraphically subdivided.

INTRODUCTION

Collections from sixteen localities, mostly in Illinois but including Iowa and Missouri, have produced a fauna characteristic of the Warsaw and Salem Formations and have indicated the nature of the Keokuk conodont fauna. The conodonts from the Warsaw and Salem represent a single biozone and are here treated as a unit. This fits well with the fact that the two formations are difficult to separate on a lithologic basis (Collinson and Swann, 1958) as well as the fact that a third formation, the Sonora, occurs in the same stratigraphic interval and is recognized at Localities 7 and 15 (figs. 1 and 2). Sonora represents an old name resurrected in recent years (Collinson, 1964) to include sandstone and sandy dolomite that is locally exposed in western Illinois and that occurs widely in the subsurface of the state. The Sonora is essentially the same age as the Salem, and the conodont fauna represents what is here informally referred to as the Warsaw-Salem fauna. Figure 1 shows the collecting localities and figure 2 gives details of the lithologies as well as conodont abundances.

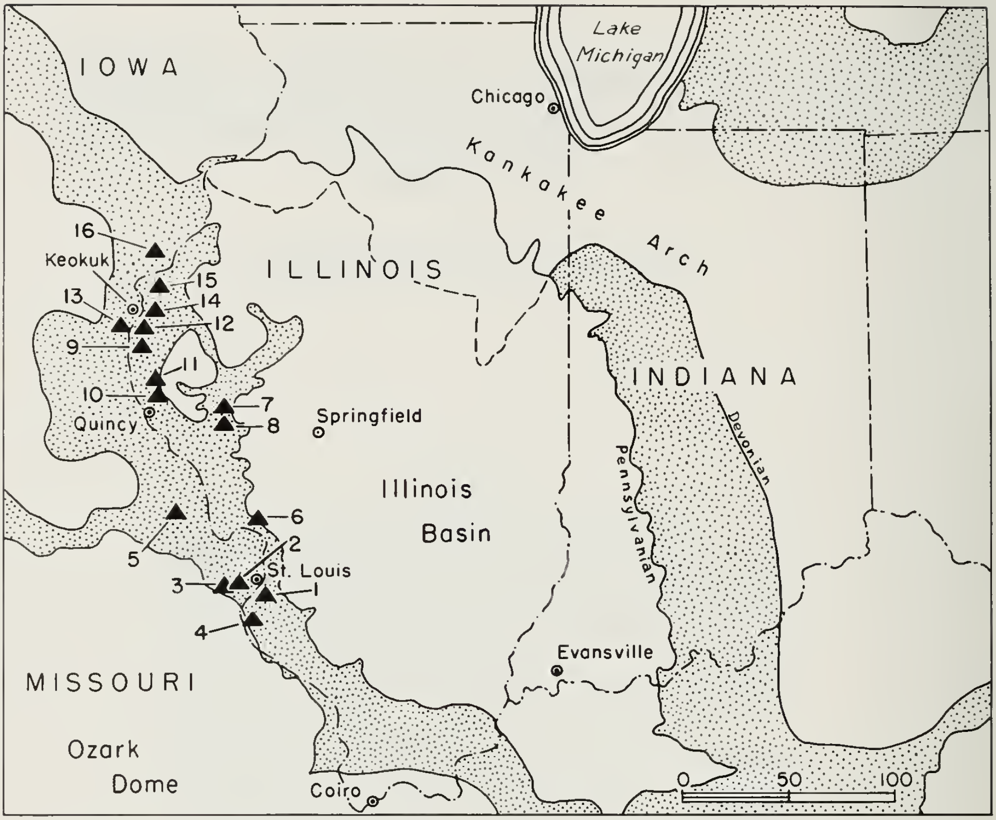


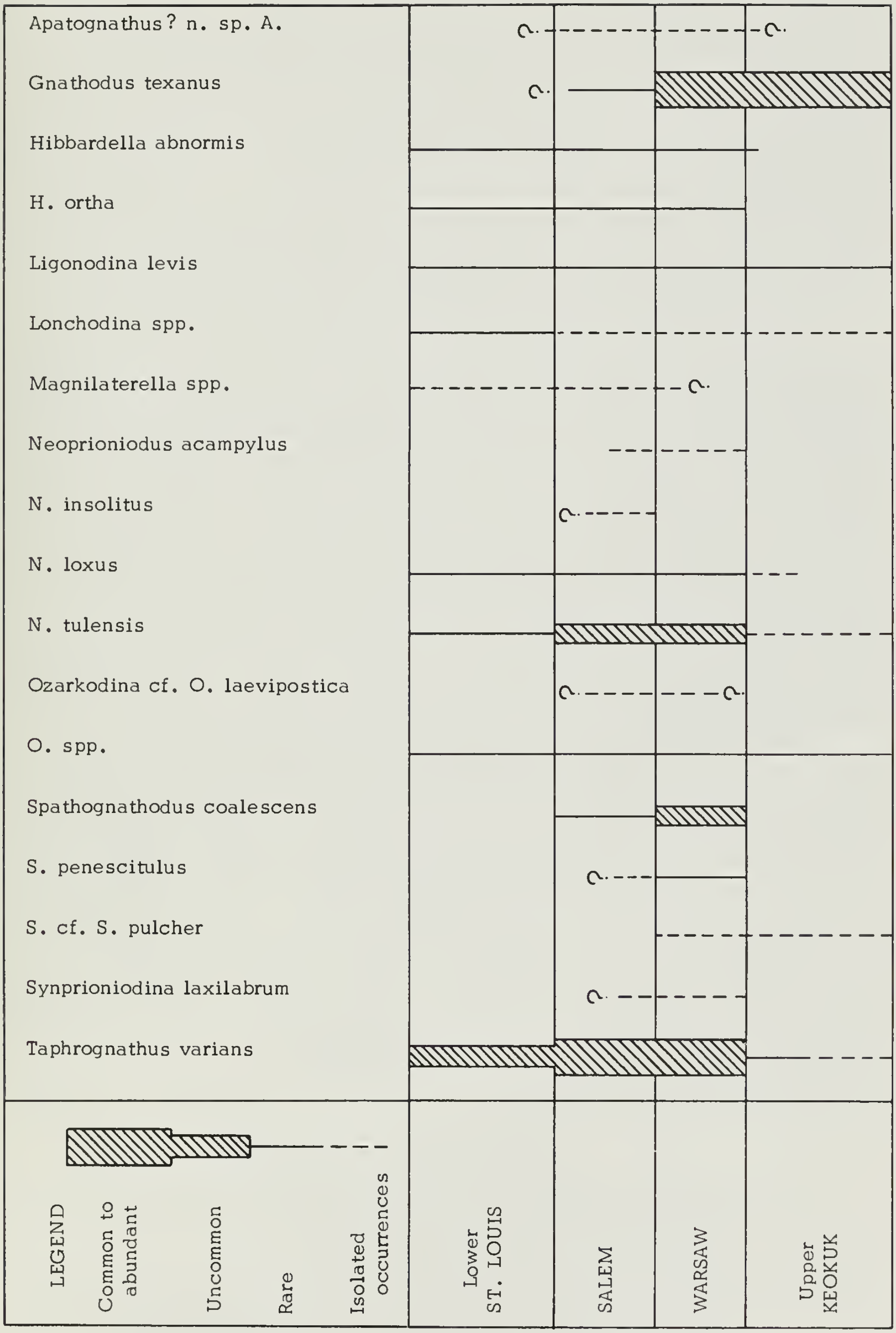
Figure 1 - Localities of the Keokuk, Warsaw, and Salem Formations from which conodonts were collected; shading indicates outcrop areas of the Kinderhookian and Valmeyeran Series. See COLLECTING LOCALITIES for location and figure 2 for descriptions.

CHARACTER OF THE FAUNAS

The Warsaw-Salem fauna consists of thirteen named species (four new) representing seven genera, plus several unnamed representatives of four additional genera. In order of abundance, the genera are Gnathodus and Taphrognathus, Neoprioniodus, Ozarkodina, Spathognathodus, Ligonodina, Hibbardella, Magnilaterella, Synprioniodina, Apatognathus? and Lonchodina. The first two are abundant; the last four are uncommon. Fragments of presumed hindeodellids are common, but their highly fragmental nature precludes an accurate count. The new species are Neoprioniodus acampylus, Spathognathodus coalescens, S. penescitulus, and Synprioniodina laxilabrum. All species are listed and their occurrences shown in the Distribution Chart, pages 16-22. Ranges are shown in table 1.

Ten species were described by Branson and Mehl (1941b) as representative of the Keokuk Formation, and even though their type and figured material probably came from the Warsaw or the Salem, eight of the ten were also found in our Keokuk samples. Their Troy locality (our Locality 5, fig. 2) represents the Salem, and the shale at their Sylvan Beach locality (our Locality 3, fig. 2), "assumed to be the

TABLE 1 - RANGES OF CONODONT SPECIES IN UPPER KEOKUK, WARSAW, SALEM, AND LOWER ST. LOUIS STRATA.



upper part of the Keokuk" (Branson and Mehl, 1941b, p. 181), probably is the Warsaw. Our study shows a general similarity between the Keokuk fauna and the Warsaw-Salem fauna in terms of the species present, but it shows that proportions of species in the two are quite different. Thus, abundances discussed by Branson and Mehl compare very closely to the relative abundances we have found for the Warsaw-Salem fauna but differ markedly from those of the Keokuk fauna. *Gnathodus texanus* (Roundy) dominates our Keokuk collection at 78 percent of the fauna. *Taphrognathus* is next at only 7 percent, and the remaining genera are minor. Because the genera other than *Gnathodus* and *Taphrognathus* are represented by such small numbers in our Keokuk collections, we cannot consider the present collection as completely representative of the formation. It is possible that several species presently not known from below the Warsaw will be found in the Keokuk.

Within the stratigraphic interval occupied by the Warsaw and Salem there is only one significant variation in the conodont fauna and that involves the relative abundance of *Gnathodus* and *Taphrognathus*. In the Warsaw, *Gnathodus* represents 44 percent of the specimens and *Taphrognathus* 20 percent; in the Salem, *Gnathodus* represents 3 percent and *Taphrognathus* 58 percent. Upward in the section, through the Keokuk, the Warsaw, and the Salem, there is a respective decrease in *Gnathodus* from 78 percent to 44 percent to 3 percent, and there is an increase in *Taphrognathus* from 7 percent to 20 percent to 58 percent. These are averages for each unit as a whole, and they do not show that there are zones of faunal transition between units just as there are lithologic transitions. The averages also do not show that the zone of transition between the faunas, which typifies the averages of the Keokuk and of the Warsaw, does not coincide precisely with the lithologic zone of transition. The lithologic units may be time transgressive, with the beds to the north being somewhat younger than the lithologic equivalents to the south.

Much of the information produced in this study was considered by Collinson, Scott, and Rexroad (1962) in their discussion of biostratigraphic zones in Devonian and Mississippian rocks of the Mississippi Valley. Their *Taphrognathus varians*-*Apatognathus*? Assemblage Zone, which includes the Warsaw, the Salem, the recently revived Sonora, and the lower part of the St. Louis Formation, is bounded below by the oldest occurrence of *Apatognathus*? and common *Taphrognathus varians*. The zone is bounded above by the youngest regular occurrence of *Taphrognathus*, the oldest occurrence of abundant *Apatognathus*?, and the oldest common occurrence of *Cavusgnathus*. It is very likely that broader studies will verify our belief that the assemblage zone can be subdivided on the basis of abundance of *Gnathodus texanus* (which dominates the Warsaw), *Taphrognathus varians* (which dominates the Salem), and other species such as *Neoprioniodus tulensis* and *Spathognathodus coalescens* (which are stratigraphically restricted).

COLLECTING LOCALITIES

The principal localities from which faunas were collected are listed below:

Locality 1: Dupo Quarry; NW¼ SW¼ sec. 27, T. 1 N., R. 10 W., St. Clair County, Illinois. Quarry in east bluff of Mississippi River.

Locality 2: Marshall Road; SE¼ sec. 11, T. 44 N., R. 5 E., St. Louis County, Missouri. Exposed along roadcut on Marshall Road.

Locality 3: Sylvan Beach; S½ sec. 14, T. 44 N., R. 5 E., St. Louis County, Missouri. Exposed along southeast side of U. S. highway 66.

Locality 4: Dennis Hollow; SW¼ sec. 2, T. 2 S., R. 11 W., Monroe County, Illinois. Exposed along highway at upper end of hollow.

Locality 5: Troy East; NW¼ NE¼ sec. 30, T. 49 N., R. 1 E., Lincoln County, Missouri.

Locality 6: Riehl Quarry; NW¼ NW¼ sec. 31, T. 6 N., R. 10 W., Madison County, Illinois.

Locality 7: Versailles West (upper); SW¼ NE¼ sec. 24, T. 2 S., R. 3 W., Brown County, Illinois. Exposed on north side of road.

Locality 8: Versailles West (lower); same as Locality 7 but south side of road.

Locality 9: Buel Branch; sec. 11, T. 2 N., R. 9 W., Adams County, Illinois.

Locality 10: Ursa North; SE¼ SE¼ SW¼ SE¼ sec. 19, T. 2 N., R. 8 W., Adams County, Illinois.

Locality 11: Sand Branch; SE¼ NW¼ sec. 28, T. 1 N., R. 8 W., Adams County, Illinois.

Locality 12: Type Warsaw; SE¼ sec. 4, NE¼ NE¼ sec. 9, and NW¼ sec. 10, T. 4 N., R. 9 W., Hancock County, Illinois. Exposed along creek at northern edge of town extending upstream to south side of highway.

Locality 13: Keokuk West; SE¼ NE¼ sec. 33, T. 65 N., R. 5 W., Lee County, Iowa. Exposed in roadcut on west side of U. S. highway 61 at north end of DesMoines River bridge.

Locality 14: Gray's Quarry; NW¼ SW¼ NE¼ sec. 31, T. 5 N., R. 8 W., Hancock County, Illinois.

Locality 15: Spillman Creek; NE¼ sec. 17, T. 7 N., R. 7 W., Hancock County, Illinois.

Locality 16: Augusta Northwest; W½ NE¼ sec. 8, T. 69 N., R. 4 W., DesMoines County, Iowa.

SYSTEMATIC PALEONTOLOGY

The type and figured specimens described and illustrated in this paper have been reposited at the Illinois State Geological Survey under collection number 23P.

Genus APATOGNATHUS Branson & Mehl, 1934

APATOGNATHUS? n. sp. A.

Pl. 1, figs. 1, 2

Although these specimens are very distinctive and do not belong to a described species, their fragmental nature precludes naming a new species even though a description is warranted.

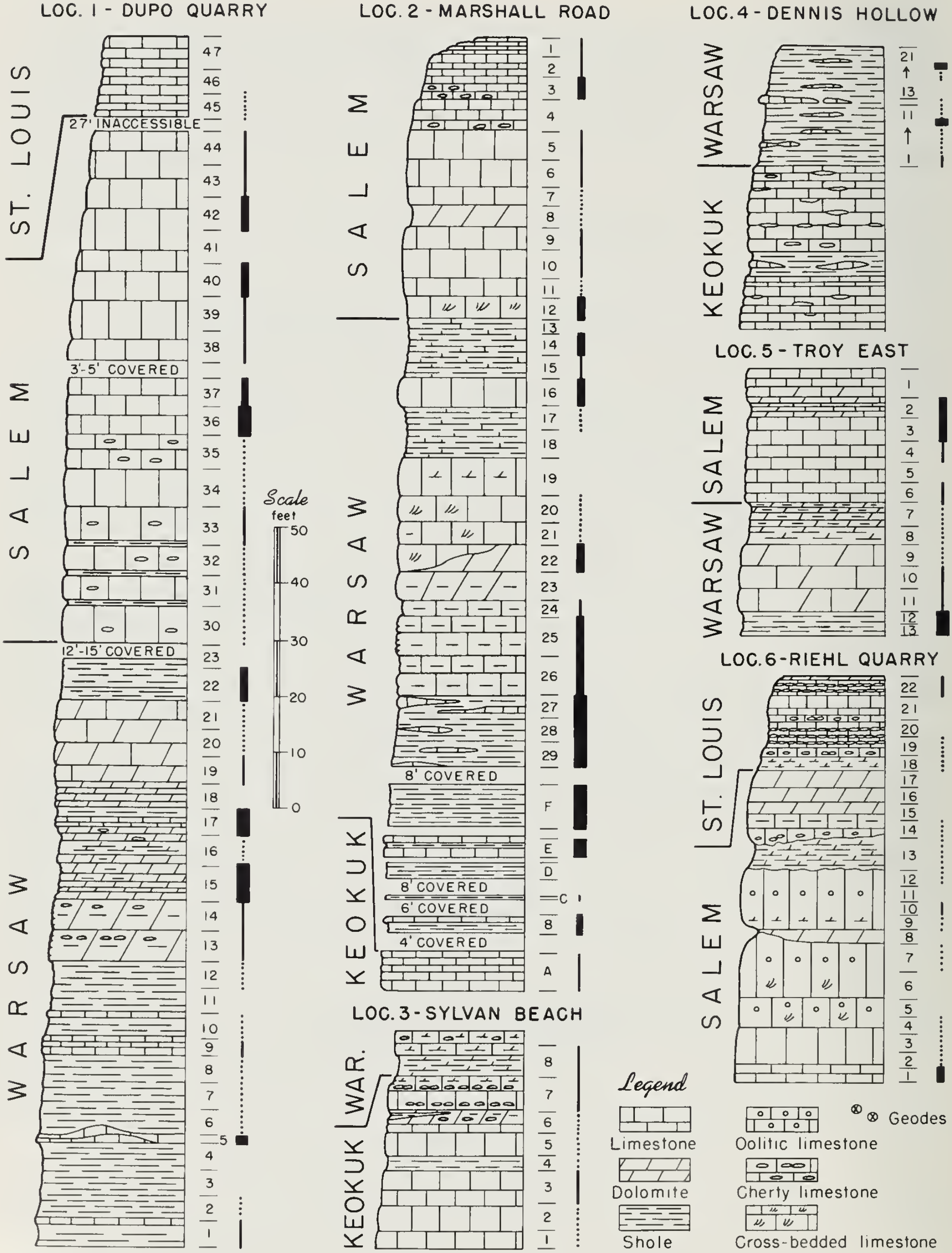
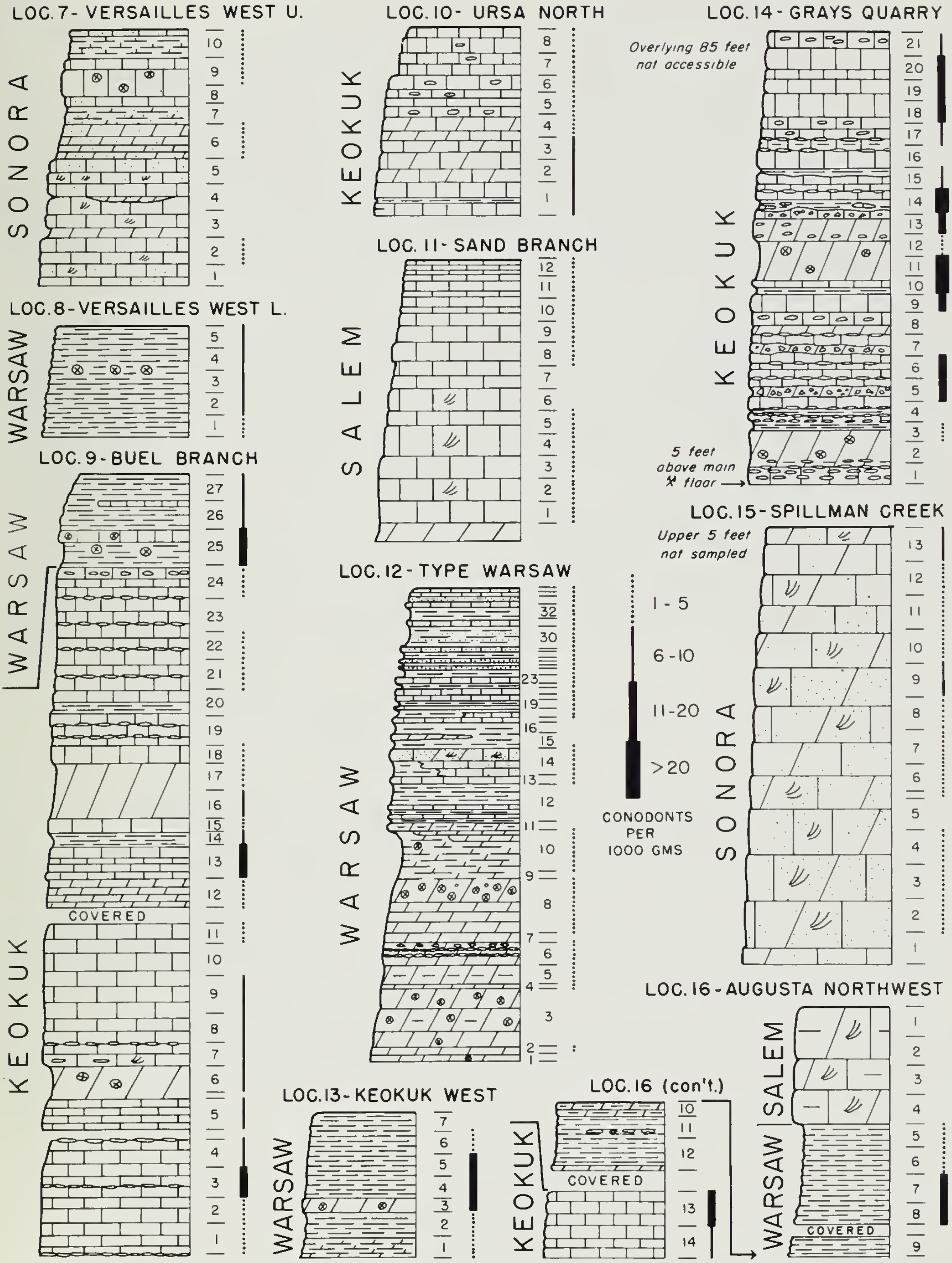


Figure 2 - Outcrop sections showing location of samples and number



of specimens collected; see COLLECTING LOCALITIES for locations.

The unit consists of two denticulate limbs surmounted at their juncture by a small apical denticle, the whole being bowed and sharply arched. Although none of the specimens has a complete posterior limb, the anterior limb appears to be the shorter and more sharply downturned. The anterior limb typically bears four or five larger proximal denticles followed distally by three or four smaller denticles. All are partially fused. Denticles of the posterior limb are partially fused, are of about the same size as the larger denticles of the anterior limb, and are either uniform in size or of uniformly graduated sizes. The laterally compressed apical denticle is about twice the size of the larger of the denticles on the limbs and is erect or only very slightly recurved. The pit at the juncture of the two limbs is minute with little if any flare along its lower margins.

Remarks.—This species differs from typical apatognathids in being less symmetrical and having a less prominent apical denticle. In these respects, it is reminiscent of Synprioniodina, and we suggest that it may be a connective link between an earlier synprioniodid and Apatognathus? porcata (Hinde) and A.? gemina (Hinde) of the St. Louis Formation. If so, the homeomorphy of Valmeyeran forms and the Upper Devonian Apatognathus suggested by Rexroad and Collinson (1963) would be substantiated. On the basis of our limited material, however, the question of homeomorphy as well as of generic placement with either Synprioniodina or Apatognathus must remain unsettled.

Material studied.—11 specimens.

Repository.—Illinois State Geological Survey 23P1, 23P2 (figured specimens).

Genus GNATHODUS Pander, 1856

GNATHODUS TEXANUS Roundy
Pl. 1, figs. 33-38

Gnathodus texanus ROUNDY, 1926, U. S. Geol. Survey Prof. Paper 146, p. 12, pl. 2, figs. 7a, b, 8a, b; HASS, 1941, Jour. Paleontology, v. 15, pl. 15, fig.4; BRANSON & MEHL, 1941a, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 173, pl. 5, figs. 23-25; HASS, 1953, U. S. Geol. Survey Prof. Paper 243-F, p. 80, pl. 14, figs. 15-21; ELIAS, 1956, Petroleum Geology of Southern Oklahoma: Am. Assoc. Petroleum Geologists, p. 116, pl. 3, figs. 32-36; BISCHOFF (part), 1957, Abh. Hess. Landesamt f. Bodenforsch, v. 19, p. 25, pl. 3, figs. 24, 25 only; MEISCHNER (part?), 1962, Abh. Hess. Landesamt f. Bodenforsch, v. 39, p. 30, 31; THOMPSON & GOEBEL, 1963, Kansas Geol. Survey Bull. 165, p. 11-13; REXROAD & SCOTT, 1964, Indiana Geol. Survey Bull. 30, p. 30-31, pl. 2, figs. 11-14.

Gnathodus texanus var. bicuspidus ROUNDY, 1926, U. S. Geol. Survey Prof. Paper 146, p. 12, pl. 2, figs. 9a, b.

Gnathodus linguiformis BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 183, pl. 6, figs. 18-26.

Spathognathodus deflexus BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 187, pl. 6, fig. 6.

Gnathodus pretexanus ELIAS (part), 1956, Petroleum Geology of Southern Oklahoma: Am. Assoc. Petroleum Geologists, v. 1, p. 115, pl. 3, figs. 9-11 only.

Specimens figured as Gnathodus texanus by Bischoff (1957, pl. 3, fig. 22 only), Voges (1959, pl. 33, figs. 40, 42 only), Kronberg, Pilger, Scherp, and Ziegler (1960, pl. 4, figs. 1, 2), and Mehl and Thomas (1947, pl. 1, fig. 3) are considered to belong with the older gnathodid species G. antetexanus Rexroad & Scott that is similar and probably ancestral to G. texanus.

The authors have studied specimens of G. texanus from both the Barnett Formation of Texas and the Caney Shale of Oklahoma and tentatively agree with Hass (1953) in placing G. linguiformis in synonomy with G. texanus. Rexroad and Scott (1964, p. 31), however, suggest the possibility of homeomorphy between the Valmeyeran and Chesterian forms, in which case G. linguiformis would be the correct designation. We further agree with Hass that G. texanus Roundy is correctly identified by Branson and Mehl from the Caney, and therefore G. pretexanus Elias, based on these specimens, is an invalid junior synonym. Further, we consider Elias's referral of Spathognathodus commutatus Branson & Mehl (part) and of G. texanus Roundy, as described by Mehl and Thomas (1947), to G. pretexanus as incorrect.

In our collection of 752 specimens of G. texanus, five lack the typical pillar arising from the platform and carina. In other specimens, the pillar is poorly developed. Because these specimens are like typical representatives of G. texanus in all other respects and are transitional with the latter, we consider them as intraspecific variants. Spathognathodus deflexus Branson & Mehl also represents this variant.

Material studied.—752 specimens.

Repository.—Illinois State Geological Survey 23P3-23P8 (figured specimens).

Genus HIBBARDELLA Ulrich & Bassler (in Bassler, 1925)

HIBBARDELLA ABNORMIS Branson & Mehl

Pl. 1, figs. 8, 9

Hibbardella abnormis BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 184-185, pl. 6, fig. 14; REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 10, pl. 2, figs. 15, 18, 20, 21.

The aboral surface of the anterior part of the posterior bar of young specimens is concave with flat sides on each side of the median groove. During ontogeny the concavity is lost and the adult may have either a flat or wedge-shaped, convex, aboral surface. The median groove remains, and the base of the bar increases in width.

Material studied.—30 specimens from this study.

Repository.—Illinois State Geological Survey 23P9, 23P10 (figured specimens).

HIBBARDELLA ORTHA Rexroad
Pl. 1, fig. 10

Hibbardella ortha REXROAD, 1958, Illinois Geol. Survey Rept. Inv. 209, p. 18, 19, pl. 2, figs. 9-12; CLARKE, 1960, Edinburgh Geol. Soc. Trans., v. 18, pt. 1, p. 6, pl. 1, fig. 7; REXROAD & BURTON, 1961, Jour. Paleontology, v. 35, p. 1153, pl. 140, figs. 5, 6; REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 10, pl. 2, figs. 12, 16; REXROAD & FURNISH, 1964, Jour. Paleontology, v. 38, p. 671, p. 111, fig. 16.

Prioniodus angulatus Hinde HINDE (part), 1900, Glasgow Nat. Hist. Soc. Trans., v. 5, n. ser., p. 343, pl. 10, fig. 18 only.

Hibbardella angulata (Hinde) HOLMES (part), 1928, U. S. Natl. Mus. Proc., v. 72, art. 5, p. 11, pl. 5, fig. 32 only.

Material studied.—19 specimens from this study.

Repository.—Illinois State Geological Survey 23P11 (figured specimen).

Genus LIGONODINA Ulrich & Bassler (in Bassler, 1925)

LIGONODINA LEVIS Branson & Mehl
Pl. 1, figs. 23, 24

Ligonodina levis BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 185, pl. 6, fig. 10; BISCHOFF, 1957, Abh. Hess. Landesamt f. Bodenforsch, v. 19, p. 30, pl. 5, figs. 8, 9, pl. 6, fig. 25; REXROAD & BURTON, 1961, Jour. Paleontology, v. 35, p. 1154, pl. 141, figs. 7, 8; REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 11, pl. 3, figs. 24, 25; THOMPSON & GOEBEL, 1963, Kansas Geol. Survey Bull. 165, p. 11-13; REXROAD & FURNISH, 1964, Jour. Paleontology, v. 38, p. 672, pl. 111, fig. 38.

Ligonodina sp. YOUNGQUIST & MILLER (part), 1949, Jour. Paleontology, v. 23, p. 620, pl. 101, figs. 12, 13 only.

Ligonodina obunca REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 32, pl. 1, figs. 22, 23; ——, 1958, Illinois Geol. Survey Rept. Inv. 209, p. 21, pl. 3, figs. 7, 8.

Material studied.—90 specimens from this study.

Repository.—Illinois State Geological Survey 23P12, 23P13 (figured specimens).

Genus LONCHODINA Ulrich & Bassler (in Bassler, 1925)

LONCHODINA spp.
Pl. 1, fig. 17

Ten fragmental specimens that probably belong to Lonchodina were too variable and poorly preserved for specific identification. A representative specimen is figured, however.

Material studied.—10 specimens.

Repository.—Illinois State Geological Survey 23P14 (figured specimen).

Genus MAGNILATERELLA Rexroad & Collinson, 1963

MAGNILATERELLA spp.
Pl. 1, fig. 7

Most specimens are similar to *Magnilaterella recurvata* (Bischoff). Unfortunately, they are too fragmental for specific reference. The material suggests quite strongly a derivation from *Ligonodina*.

Material studied.—16 specimens.

Repository.—Illinois State Geological Survey 23P15 (figured specimen).

Genus NEOPRIONIODUS Rhodes & Müller, 1956

NEOPRIONIODUS ACAMPYLUS Rexroad & Collinson, n. sp.
Pl. 1, figs. 25-27

Diagnosis.—This is a small neoprioniodid which is unbowed except for the terminal fang. It bears deeply inserted denticles on the straight posterior bar that makes an angle of 55° with the long anticusp.

Description.—The small unit has a somewhat bowed terminal fang and anticusp that form a nearly straight unit as viewed laterally. The nearly straight posterior bar forms an angle of approximately 55° with the anterior margin of the anticusp. The denticles of the bar are of the same thickness as the bar, are somewhat variable in width, and are deeply inserted with the free ends short and acutely pointed. Even though no specimens were complete, we estimate that twenty is the maximum number of denticles. The small, deep pit is located at the juncture of the posterior bar and the anticusp, has a flaring inner lip, and has an outer lip conforming to the surface of the bar and fang. It continues as a faint groove for a short distance on the aboral edge of the posterior bar.

Remarks.—The species is somewhat similar to *Neoprioniodus camurus* Rexroad but is unbowed in contrast to the latter, which is very sharply bowed, especially immediately posterior to the fang. The denticles of *N. camurus*, although fused, are not deeply inserted.

Material studied.—12 specimens.

Repository.—Illinois State Geological Survey 23P16 (holotype), 23P15, 23P17 (paratypes).

NEOPRIONIODUS INSOLITUS Hass
Pl. 1, fig. 18

Neoprioniodus insolitus HASS, 1959, U. S. Geol. Survey Prof. Paper 294-J, p. 383-384, pl. 48, figs. 19, 22.

It is possible that the single specimen found in the Warsaw-Salem is reworked from older beds.

Material studied.—1 specimen.

Repository.—Illinois State Geological Survey 23P19 (figured specimen).

NEOPRIONIODUS LOXUS Rexroad
Pl. 1, figs. 11, 19

Neoprioniodus loxus REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 34, pl. 2, figs. 8, 9, 14; ——, 1958, Illinois Geol. Survey Rept. Inv. 209, p. 23, pl. 5, figs. 7-9; REXROAD & BURTON, 1961, Jour. Paleontology, v. 35, p. 1155, pl. 140, fig. 12; REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 18, pl. 2, fig. 28; THOMPSON & GOEBEL, 1963, Kansas Geol. Survey Bull. 165, p. 11-13; REXROAD & FURNISH, 1964, v. 38, p. 674, pl. 111, fig. 32.

Neoprioniodus tenuis REXROAD, 1957, Illinois Geol. Survey Rept. Inv. 199, p. 35, pl. 2, figs. 13, 16.

Prioniodus sp. indet. BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 186, pl. 6, figs. 8, 9.

Material studied.—46 specimens from this study.

Repository.—Illinois State Geological Survey 23P20, 23P21 (figured specimens).

NEOPRIONIODUS TULENSIS (Pander)
Pl. 1, figs. 28, 29

Prioniodus tulensis PANDER (part), 1856, Mono. der fossilen Fische des silurischen Systems, p. 30, pl. 2A, fig. 1 only; HOLMES (part), 1928, U. S. Natl. Mus. Proc., v. 72, art. 5, p. 22, pl. 3, fig. 18 only.

Prioniodus cassilaris BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 186, pl. 6, figs. 11, 12, 15, 17.

Neoprioniodus cassilaris (Branson & Mehl) ELIAS (part), 1959, p. 153-154, pl. 2, figs. 17-19 only.

Neoprioniodus cassilaris var. keokukensis ELIAS, 1959, p. 154, pl. 2, fig. 22.

Prioniodina cassilaris (Branson & Mehl) BISCHOFF, 1957, Abh. Hess. Landesamt f. Bodenforsch, v. 19, p. 46, pl. 5, figs. 27-31.

Neoprioniodus tulensis (Pander) REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 18, pl. 2, figs. 17, 22, 23.

Material studied.—76 specimens from this study.

Repository.—Illinois State Geological Survey 23P22, 23P23 (figured specimens).

Genus OZARKODINA Branson & Mehl, 1933

OZARKODINA cf. O. LAEVIPOSTICA Rexroad & Collinson
Pl. 1, fig. 12

The few specimens in our collection resemble both *Ozarkodina laevipostica* from the overlying St. Louis Limestone and variants of *Subbryantodus radians* Branson & Mehl from older beds. It seems likely that these species represent members of a lineage. The specimens of this study are more closely similar to *O. laevipostica* but differ in having a larger pit, denticulate posterior bar, and essentially unfused denticles. Some specimens of *O. laevipostica*, particularly the young, do have denticles on the posterior bar, and this ontogenetic stage probably reflects the suggested ancestry.

Material studied.—3 specimens.

Repository.—Illinois State Geological Survey 23P24 (figured specimen).

OZARKODINA spp.
Pl. 1, fig. 6

Although specimens of *Ozarkodina* are common, they are so fragmental that specific reference is not possible.

Material studied.—183 specimens.

Repository.—Illinois State Geological Survey 23P25 (figured specimen).

Genus SPATHOGNATHODUS Branson & Mehl, 1941

SPATHOGNATHODUS COALESCENS Rexroad & Collinson, n. sp.
Pl. 1, figs. 20-22

Spathognathodus sp. indet. BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 188, pl. 6, figs. 4-5.

Diagnosis.—Specimens are long and nearly straight with a prominent denticle at the anterior end and the remaining denticles fused or nearly fused to their apices. The pit is nearly three-fourths the length of the specimen and extends to the posterior tip.

Description.—The thin, bladelike unit is straight or slightly bowed, and its height at mid-length is about two-fifths the total length. A prominent cusp is present at the anterior. Posterior to the cusp the denticles, approximately fifteen in number, are fused or nearly fused to their apices. Viewed laterally, the oral margin is straight or slightly concave upward along the midportion, rises anteriorly toward the anterior cusp, and is curved sharply downward (aborally) toward the posterior. The pit is large and nearly symmetrical. It occupies almost three-fourths of the aboral margin of the specimen, is widest and deepest near its anterior, and extends to the posterior tip. The aboral margin anterior to the pit is sharp edged and is inclined aborally.

EXPLANATION OF PLATE 1

All figures X40

Numbers in parentheses refer to locality and sample number.

FIGURE	
1, 2	*Apatognathus*? n. sp. A. Inner lateral views (9-27, 15-13).
3-5	*Synprioniodina laxilabrum* Rexroad & Collinson, n. sp. 3, inner lateral view of holotype (2-29); 4, outer lateral view of paratype (2-29); 5, inner lateral view of paratype, a young specimen (2-29).
6	*Ozarkodina* sp. Inner lateral view (2-15).
7	*Magnilaterella* sp. Oblique posterior view (2-29).
8, 9	*Hibbardella abnormis* Branson & Mehl. 8, aboral view (2-27); 9, oblique aboral view of young specimen (1-36).
10	*Hibbardella ortha* Rexroad. Lateral view (5-12).
11, 19	*Neoprioniodus loxus* Rexroad. Inner lateral views (2-29, 2-27, respectively).
12	*Ozarkodina* cf. *O*. *laevipostica* Rexroad & Collinson. Inner lateral view (2-F).
13-15	*Spathognathodus penescitulus* Rexroad & Collinson, n. sp. 13, inner lateral view of holotype (2-28); 14, inner lateral view of paratype, a young specimen (8-2); 15, inner lateral view of paratype (1-14).
16	*Spathognathodus* cf. *S*. *pulcher* Branson & Mehl. Inner lateral view (2-15).
17	*Lonchodina* sp. Inner lateral view (1-33).
18	*Neoprioniodus insolitus* Hass. Inner lateral view (11-4).
20-22	*Spathognathodus coalescens* Rexroad & Collinson, n. sp. 20, inner lateral view of paratype (9-25); 21, outer lateral view of paratype (9-25); 22, outer lateral view of holotype (16-7).
23, 24	*Ligonodina levis* Branson & Mehl. Inner lateral views (2-22, 8-5).
25-27	*Neoprioniodus acampylus* Rexroad & Collinson, n. sp. 25, inner lateral view of paratype (8-5); 26, inner lateral view of holotype (9-27); 27, outer lateral view of paratype (13-5).
28, 29	*Neoprioniodus tulensis* (Pander). Inner lateral views (2-29, 6-7).
30-32	*Taphrognathus varians* Branson & Mehl. 30, aboral view (2-17); 31, oral view (1-19); 32, lateral view (2-27).
33-38	*Gnathodus texanus* Roundy. 33, outer lateral view (2-C); 34, outer lateral view (6-10); 35, oral view (2-27); 36, inner lateral view (2-C); 37, oral view (16-6); 38, inner lateral view (1-8).

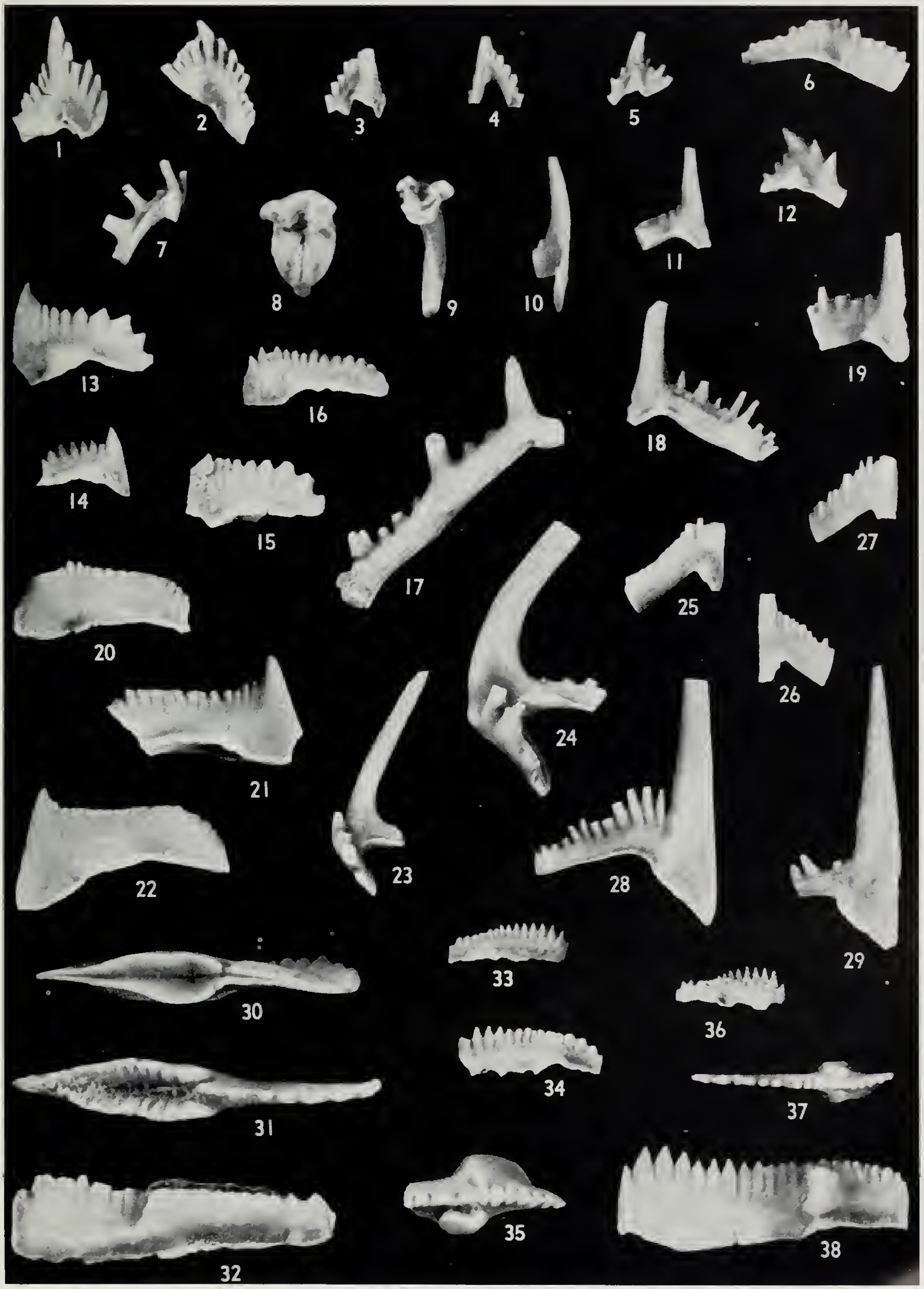


PLATE 1

REXROAD & COLLINSON

ABUNDANCE AND DISTRIBUTION CHART OF

Samples averaged approximately 1 kilogram each. Localities

LOCALITY 1. – DUPO QUARRY

Formation	WARSAW																										
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	30	31	32	33
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gnathodus texanus	6	2	–	–	23	5	3	2	4	3	–	4	4	3	2	–	2	–	–	–	–	–	–	–	–	–	–
Hibbardella abnormis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	2	–	1	–	1	–	–	1	–	–	–
Lonchodina spp	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Magnilaterella spp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	1	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–
N. tulensis	1	–	–	–	–	–	–	–	1	–	–	–	–	–	4	–	2	–	1	1	–	–	–	1	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	4	–	1	–	–	3	–	–	–	–	–
Spathognathodus coalescens	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
S. penescitulus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Taphrognathus varians	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	4	–	2	1	2	2	–	1	2	1	3
Taphrognathus sp.	–	–	–	–	3	–	–	–	–	–	–	–	2	1	6	–	11	–	2	–	1	2	2	1	2	2	3

LOCALITY 2.– MARSHALL ROAD

Formation	SALEM												WARSAW														
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Apatognathus? n. sp. A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Gnathodus texanus	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	16
Hibbardella abnormis	1	–	1	–	1	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	4
H. ortha	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	1	1	–	–	–	1	–	–	–	1	–	–	–	2	–	–	–	–	–	–	–	2	–	–	1	3	8
Lonchodina spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	1
Magnilaterella spp.	–	1	–	–	1	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	2	–	1
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
N. loxus	–	1	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	3
N. tulensis	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	–	3	1	–	6
N. varians	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	2	–	1	–	2	–	1	–	–	1	–	2	4	–	3	–	–	–	–	3	–	–	–	–	7
Spathognathodus coalescens	–	–	–	–	–	–	–	–	–	2	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	10
S. penescitulus	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–	–	4	1	–	–	–	–	–	–	1	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
Taphrognathus varians	1	3	6	–	1	2	–	–	1	3	2	3	–	1	1	5	–	–	–	–	–	1	–	–	4	2	3
Taphrognathus sp.	1	–	6	–	5	2	–	–	2	1	1	4	–	1	3	6	–	–	–	1	1	1	–	3	7	9	13

CONODONT SPECIES BY SAMPLE AND LOCALITY
are not all in consecutive order due to space limitations.

											LOCALITY 3.– SYLVAN BEACH								
SALEM											Formation	KEOKUK							WARSAW
34	35	36	37	38	39	40	41	42	43	44	Sample No.	1	2	3	4	5	6	7	8
–	–	–	–	–	–	–	–	–	–	–	Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–
–	–	–	–	1	–	3	–	–	–	–	Gnathodus texanus	4	2	10	3	–	1	6	6
–	–	2	–	–	–	–	–	–	–	–	Hibbardella abnormis	–	–	–	–	–	–	–	–
1	1	–	–	2	3	–	–	–	–	–	H. ortha	–	–	–	–	–	–	–	–
–	1	–	1	–	–	–	–	–	–	–	Ligonodina levis	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	–	–	–	–	Lonchodina spp.	–	–	–	–	–	–	–	–
–	–	–	–	–	–	2	–	–	–	–	Magnilaterella spp.	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	Neoprioniodus acampylus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	N. insolitus	–	–	–	–	–	–	–	–
–	–	1	–	1	2	4	–	–	–	–	N. loxus	–	–	–	–	–	–	–	–
1	–	–	1	1	–	–	–	1	–	–	N. tulensis	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	N. varians	–	–	–	–	–	–	–	–
–	1	2	2	–	1	–	–	–	–	–	Ozarkodina spp.	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	Spathognathodus coalescens	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	S. penescitulus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	S. cf. S. pulcher	–	–	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	Synprioniodina laxilabrum	–	–	–	–	–	–	–	–
1	–	6	5	5	2	4	–	2	1	3	Taphrognathus varians	–	–	–	–	–	–	–	–
1	1	13	7	–	2	2	–	10	5	3	Taphrognathus sp.	–	–	–	–	–	–	–	–

								LOCALITY 4.– DENNIS HOLLOW																			
							KEO-KUK?	Formation	WARSAW																		
28	29	F	E	D	C	B	A	Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
–	1	–	–	–	–	–	–	Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
73	64	28	15	–	5	11	5	Gnathodus texanus	6	13	–	–	1	2	2	–	32	1	2	3	–	–	–	1	5	35	–
1	1	2	1	–	–	–	–	Hibbardella abnormis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	3	2	2	–	–	–	–	H. ortha	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	7	3	4	–	–	–	1	Ligonodina levis	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	Lonchodina spp.	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–
1	2	1	1	–	–	–	–	Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	4	–	–	–	–	–	–	Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	N. insolitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	5	6	2	–	–	–	–	N. loxus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	11	2	2	–	1	–	–	N. tulensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	N. varians	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6	9	3	3	–	–	–	–	Ozarkodina spp.	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	1	2	–	–	–	–	–	Spathognathodus coalescens	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	1	1	–	–	–	–	–	S. penescitulus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	–	–	–	–	–	S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	3	2	–	–	–	–	–	Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	4	7	2	–	1	2	–	Taphrognathus varians	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6	2	5	4	–	–	1	–	Taphrognathus sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

ABUNDANCE AND DISTRIBUTION

LOCATITY 5.– TROY EAST

Formation	SALEM											WARSAW	
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–	1	1
Gnathodus texanus	–	–	–	–	–	–	–	–	–	–	–	1	1
Hibbardella abnormis	–	–	1	–	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	1	–	–	–	–	–	2	2
Ligonodina levis	–	2	–	1	–	1	–	–	1	–	1	–	1
Lonchodina spp.	–	–	–	–	–	–	–	–	1	–	–	2	1
Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–	–	1
N. insolitus	–	–	–	–	–	–	–	–	–	–	–	–	–
N. loxus	–	2	–	–	–	–	–	–	–	–	1	2	2
N. tulensis	–	–	–	–	–	–	–	1	1	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	1	–	–	–	–	–	–	–	–	1	3	4
Spathognathodus coalescens	–	–	2	1	–	1	–	–	–	–	–	8	6
S. penescitulus	–	–	–	–	–	1	–	–	–	–	–	–	1
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–	–
Synprioniodina laxilabrum	–	1	–	–	–	–	–	–	–	–	–	–	1
Taphrognathus varians	–	6	2	3	–	2	1	1	–	1	3	10	6
Taphrognathus sp.	–	6	9	3	–	7	2	1	1	5	3	6	8

LOCALITY 6.–

Formation					
Sample No.	1	2	3	4	5
Apatognathus? n. sp. A.	–	–	–	–	–
Gnathodus texanus	–	1	–	–	–
Hibbardella abnormis	1	–	1	–	–
H. ortha	–	–	–	–	–
Ligonodina levis	2	1	1	1	–
Lonchodina spp.	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–
N. insolitus	–	–	–	–	–
N. loxus	–	–	–	–	–
N. tulensis	2	–	–	2	–
N. varians	–	–	–	–	–
Ozarkodina spp.	–	–	1	–	–
Spathognathodus coalescens	–	–	1	–	–
S. penescitulus	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–
Taphrognathus varians	2	1	–	–	–
Taphrognathus sp.	4	–	3	1	–

LOCALITY 7. – VERSAILLES WEST U.

Formation	SALEM									
Sample No.	1	2	3	4	5	6	7	8	9	10
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	1	1
Gnathodus texanus	–	–	–	–	–	–	–	–	–	–
Hibbardella abnormis	–	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	–	–	–
Lonchodina spp.	–	1	–	–	–	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	–	–
N. tulensis	–	–	–	–	–	–	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	–	–	–	–	–	–	–	–
Spathognathodus coalescens	–	–	–	–	–	–	–	–	1	–
S. penescitulus	–	–	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–
Taphrognathus varians	–	–	–	–	–	–	–	–	–	–
Taphrognathus sp.	–	–	–	–	–	1	–	–	–	–

LOCALITY 9.–

Formation									
Sample No.	1	2	3	4	5	6	7	8	9
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–
Gnathodus texanus	1	–	16	6	3	5	3	7	1
Hibbardella abnormis	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	2	2
Lonchodina spp.	–	–	–	–	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	–
N. tulensis	–	–	–	–	2	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	–	–	–	–	–	–	1
Spathognathodus coalescens	–	2	2	1	1	–	–	–	–
S. penescitulus	–	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	1	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–
Taphrognathus varians	–	–	1	–	–	–	–	–	1
Taphrognathus sp.	–	–	2	–	–	–	1	–	3

CHART – Continued

RIEHL QUARRY																						LOCALITY 8.–VERSAILLES WEST L.					
SALEM																	ST. LOUIS					Formation	WARSAW				
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Sample No.	1	2	3	4	5
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Apatognathus? n. sp. A.	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Gnathodus texanus	1	2	3	1	–
–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	Hibbardella abnormis	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	H. ortha	–	–	–	–	–
–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	Ligonodina levis	–	1	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Lonchodina spp.	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	Magnilaterella spp.	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Neoprioniodus acampylus	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. insolitus	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3	N. loxus	–	–	–	1	1
–	–	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	1	–	N. tulensis	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. varians	–	–	–	–	–
–	–	–	–	–	–	1	–	1	–	–	–	–	1	–	–	–	–	1	–	–	1	Ozarkodina spp.	1	2	1	2	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Spathognathodus coalescens	–	1	2	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S. penescitulus	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S. cf. S. pulcher	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Synprioniodina laxilabrum	–	–	–	–	–
–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	2	2	Taphrognathus varians	–	–	1	2	2
–	–	–	1	4	–	–	–	2	–	–	–	2	1	–	–	–	–	–	–	–	–	Taphrognathus sp.	–	–	–	1	1

BUEL BRANCH																		LOCALITY 10.– URSA NORTH								
KEOKUK														WARSAW				Formation	KEOKUK							
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Sample No.	1	2	3	4	5	6	7	8
–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	1	Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–
–	–	–	8	–	2	6	2	3	–	–	–	–	–	–	6	6	1	Gnathodus texanus	9	5	6	4	3	–	3	3
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	Hibbardella abnormis	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	H. ortha	–	–	–	–	–	–	–	–
–	–	–	2	–	–	–	2	–	–	–	–	–	–	–	–	–	–	Ligonodina levis	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Lonchodina spp.	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Magnilaterella spp.	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	Neoprioniodus acampylus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. insolitus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. loxus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. tulensis	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N. varians	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	Ozarkodina spp.	–	–	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	Spathognathodus coalescens	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S. penescitulus	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S. cf. S. pulcher	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Synprioniodina laxilabrum	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	1	2	Taphrognathus varians	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	1	–	Taphrognathus sp.	–	–	–	–	–	–	1	2

ABUNDANCE AND DISTRIBUTION

LOCALITY 11. – SAND BRANCH

Formation	SALEM											
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–	–
Gnathodus texanus	–	–	–	–	–	–	–	–	1	–	–	–
Hibbardella abnormis	1	–	–	–	–	–	–	–	–	–	–	–
H. ortha	–	1	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	–	–	–	–	–
Lonchodina spp.	–	–	–	–	–	–	–	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	1	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	–	–	–	–
N. tulensis	–	–	–	–	–	–	–	–	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	1	–	2	–	–	–	–	–	–	1
Spathognathodus coalescens	–	–	–	–	–	–	–	2	–	–	1	–
S. penescitulus	–	–	–	–	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–	–
Taphrognathus varians	–	–	–	–	–	–	–	–	–	–	–	–
Taphrognathus sp.	1	1	–	–	1	–	–	–	1	2	1	–

Formation
Sample No.
Apatognathus? n. sp. A.
Gnathodus texanus
Hibbardella abnormis
H. ortha
Ligonodina levis
Lonchodina spp.
Magnilaterella spp.
Neoprioniodus acampylus
N. insolitus
N. loxus
N. tulensis
N. varians
Ozarkodina spp.
Spathognathodus coalescens
S. penescitulus
S. cf. S. pulcher
Synprioniodina laxilabrum
Taphrognathus varians
Taphrognathus sp.

LOCALITY 13. – KEOKUK WEST

Formation	WARSAW						
Sample No.	1	2	3	4	5	6	7
Apatognathus? n. sp. A.	–	–	–	1	–	–	–
Gnathodus texanus	–	1	3	4	10	1	–
Hibbardella abnormis	–	–	–	–	–	–	–
H. ortha	–	–	–	–	1	–	–
Ligonodina levis	–	–	3	2	–	–	–
Lonchodina spp.	–	–	–	–	–	–	–
Magnilaterella spp.	–	1	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	1	–	–
N. insolitus	–	–	–	–	–	–	–
N. loxus	–	1	1	–	1	–	–
N. tulensis	–	–	–	2	–	1	–
N. varians	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	–	–	–	–	–
Spathognathodus coalescens	1	–	2	–	2	–	–
S. penescitulus	–	–	–	–	1	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–
Taphrognathus varians	–	–	–	4	–	–	–
Taphrognathus sp.	–	1	2	4	2	–	–

LOCALITY 14.–

Formation	KEOKUK										
Sample No.	1	2	3	4	5	6	7	8	9	10	11
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–
Gnathodus texanus	–	–	2	–	12	15	–	–	18	25	26
Hibbardella abnormis	–	–	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	–	–	–	–
Lonchodina spp.	–	–	–	–	–	–	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	–	1	–
N. tulensis	–	–	–	–	–	–	–	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	–	–	–	–	–	–	–	–	–
Spathognathodus coalescens	–	–	–	–	–	–	–	–	–	–	–
S. penescitulus	–	–	–	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	1	–	–	1	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–
Taphrognathus varians	–	–	–	–	–	–	–	–	–	–	–
Taphrognathus sp.	–	–	–	–	–	–	–	–	–	–	–

CHART – Continued

LOCALITY 12.– TYPE WARSAW

WARSAW																																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	2	–	–	–	–	1	3	–	–	–	–	–	1	–	–	–	–	–	1	–	–	1	1	–	–	–	4	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–	1	–	–	1	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	2	–	–	–	–	–	–	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	2	–	1	–	–	–	–	2	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	1	1	–	–	1	–	1	–	–	1	–	–	–	–	1	–	–	–	1	–	–	2	1	1	1	–	–	–	–	1	1	–

GRAYS QUARRY

12	13	14	15	16	17	18	19	20	21
–	–	–	–	–	–	–	–	–	–
4	12	25	5	–	5	3	8	8	9
–	–	–	–	–	–	1	1	–	–
–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	1	–	1	–
–	–	1	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	2	–	1	–
–	–	–	–	–	–	–	–	–	–
–	–	–	3	–	–	1	1	2	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	1	–	–	1	–	–	–
–	–	2	–	–	2	1	–	–	–

LOCALITY 15.– SPILLMAN CREEK

Formation	SALEM												
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Apatognathus? n. sp. A.	–	–	–	–	–	–	–	–	–	–	–	–	1
Gnathodus texanus	–	–	–	–	–	–	–	–	1	–	–	1	3
Hibbardella abnormis	–	–	–	–	–	–	–	–	–	–	–	–	–
H. ortha	–	–	–	–	–	–	–	–	–	–	–	–	–
Ligonodina levis	–	–	–	–	–	–	–	2	–	–	–	–	–
Lonchodina spp.	–	–	–	–	–	–	–	–	–	–	–	–	–
Magnilaterella spp.	–	–	–	–	–	–	–	–	–	–	–	–	–
Neoprioniodus acampylus	–	–	–	–	–	–	–	–	–	–	–	–	–
N. insolitus	–	–	–	–	–	–	–	–	–	–	–	–	–
N. loxus	–	–	–	–	–	–	–	–	–	–	–	1	–
N. tulensis	–	–	–	1	–	–	–	–	–	–	–	–	–
N. varians	–	–	–	–	–	–	–	–	–	–	–	–	–
Ozarkodina spp.	–	–	–	–	–	–	–	–	1	–	–	–	–
Spathognathodus coalescens	–	–	1	–	–	1	1	–	4	1	1	2	–
S. penescitulus	–	–	–	–	–	–	–	–	–	–	–	–	–
S. cf. S. pulcher	–	–	–	–	–	–	–	–	–	–	–	–	–
Synprioniodina laxilabrum	–	–	–	–	–	–	–	–	–	–	–	–	–
Taphrognathus varians	–	–	–	–	–	–	–	1	–	1	1	–	–
Taphrognathus sp.	–	1	–	2	–	1	–	1	4	1	–	–	4

ABUNDANCE AND DISTRIBUTION CHART - Continued

LOCALITY 16.- AUGUSTA NORTHWEST

Formation	SALEM				WARSAW								KEOKUK	
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Apatognathus? n. sp. A.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gnathodus texanus	-	-	-	-	-	1	7	9	-	-	-	-	2	5
Hibbardella abnormis	-	-	-	-	-	-	-	-	-	-	-	-	1	-
H. ortha	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ligonodina levis	-	-	-	-	-	-	-	1	-	-	-	-	1	-
Lonchodina spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnilaterella spp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Neoprioniodus acampylus	-	-	-	-	-	-	1	-	-	-	-	-	-	-
N. insolitus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. loxus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. tulensis	-	-	-	-	-	-	-	2	-	-	-	-	4	-
N. varians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ozarkodina spp.	-	-	-	-	-	1	1	-	-	-	-	-	1	-
Spathognathodus coalescens	-	-	-	-	-	-	2	-	-	-	-	-	-	-
S. penescitulus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. cf. S. pulcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synprioniodina laxilabrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Taphrognathus varians	-	-	-	-	-	-	1	-	-	-	-	-	-	2
Taphrognathus	-	-	-	-	-	-	3	-	-	-	-	-	2	2

Remarks.-Like *Spathognathodus penescitulus*, n. sp., this species probably developed from *S. regularis* Branson & Mehl, but it does not seem to be closely related to any younger spathognathodids.

Material studied.-52 specimens.

Repository.-Illinois State Geological Survey 23P26 (holotype), 23P27-23P29 (paratypes).

SPATHOGNATHODUS PENESCITULUS Rexroad & Collinson, n. sp.

Pl. 1, figs. 13-15

Spathognathodus regularis Branson & Mehl BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 187, pl. 6, fig. 7.

Diagnosis.-This is a short spathognathodid with a large pit extending about three-fourths of its length. There is a prominent anterior denticle generally followed by eight denticles, three small and deeply inserted, three larger, and two small and unfused.

Description.-The unit is straight to slightly bowed and is approximately twice as long as high. Posterior to the prominent anterior cusp are three, or rarely four, narrow, deeply inserted denticles followed by three, or rarely four, larger denticles. At the posterior are two smaller, unfused denticles. The outline viewed laterally is convex upward, curving regularly downward toward the posterior. The deep pit, which has widely flaring lips, is about three-fourths the length of the individual. It is widest and deepest near the anterior, and it extends to the posterior tip. The aboral margin anterior to the pit is sharp edged and inclined aborally toward the anterior. Immature specimens have nearly equal, less fused denticles.

Remarks.—The general shape is similar to Spathognathodus scitulus (Hinde), but in the latter the pit is confined to the mid-length and is strongly asymmetrical. Almost certainly S. penescitulus is ancestral to S. scitulus and is itself derived from S. regularis (Branson & Mehl). S. scitulus closely resembles the specimen figured by Branson and Mehl (1938, pl. 34, fig. 2) as a young individual but has a deeper pit that extends completely to the posterior. These are characteristics referred to S. regularis by Branson and Mehl (1941b), and we accordingly consider their Warsaw-Salem specimens conspecific with S. penescitulus.

Material studied.—12 specimens.

Repository.—Illinois State Geological Survey 23P32 (holotype), 23P33, 23P34 (paratypes).

SPATHOGNATHODUS cf. S. PULCHER Branson & Mehl
Pl. 1, fig. 16

Spathodus pulcher BRANSON & MEHL, 1938, Missouri Univ. Studies, v. 13, no. 4, p. 139-140, pl. 34, figs. 7, 8.

Our specimens are similar to Spathognathodus pulcher Branson & Mehl, but they lack the one or two higher denticles at the anterior end. Although they may well represent a new species, enough complete specimens are not available to warrant naming it.

Material studied.—13 specimens.

Repository.—Illinois State Geological Survey 23P35 (figured specimen).

Genus SYNPRIONIODINA Ulrich & Bassler (in Bassler, 1925)

SYNPRIONIODINA LAXILABRUM Rexroad & Collinson, n. sp.
Pl. 1, figs. 3-5

Diagnosis.—This is a small unit with a widely flaring inner lateral lip on the pit, at the juncture of the posterior bar and the anticusp, which form an angle of about 45° as viewed laterally. The apical denticle is small and bowed but not recurved.

Description.—The apical denticle is only slightly compressed but is sharp edged anteriorly and posteriorly. It is bowed with greatest curvature near the base, but it is not recurved. The posterior bar is slightly arched and bowed. It bears erect, appressed and compressed denticles with sharp-pointed free tips. The anticusp bears erect denticles fused to or nearly to their apices. In immature specimens, denticles of both the bar and anticusp may be free. Anticusp and posterior bar unite below the main cusp at an angle of about 45° as viewed laterally. The pit is located at their juncture and has a strongly flared inner lip, as well as a short outer lip that conforms to the outer surface of the bar and anticusp. Faint grooves extend from the pit along the aboral margin of the posterior bar and the anticusp.

Remarks.—Two figured specimens referred by Bischoff (1957, pl. 5, figs. 21, 25) to Prioniodina prona (Huddle) may well belong to S. laxilabrum, but no decision can be made from the figures alone. S. laxilabrum is closely similar to several specimens that Cooper (1939) describes as Euprioniodina aphanes Cooper, E. gracilis Branson & Mehl, Telumondina gracilis Cooper, and T. apalus Cooper. Examination of topotype material leads to the conclusion that S. laxilabrum developed from an ancestor of the kind figured by Cooper under all of these names.

A few specimens of S. laxilabrum are present in our collections from the Barnett Formation of Texas and the Caney Shale of Oklahoma.

Material studied.—11 specimens.

Repository.—Illinois State Geological Survey 23P36 (holotype), 23P37, 23P38 (paratypes).

Genus TAPHROGNATHUS Branson & Mehl, 1941

TAPHROGNATHUS VARIANS Branson & Mehl
Pl. 1, figs. 30-32

Taphrognathus varians BRANSON & MEHL, 1941b, Denison Univ. Bull., Jour. Sci. Labs., v. 35, p. 182-183, pl. 6, figs. 27-33, 35-40; REXROAD & COLLINSON, 1963, Illinois Geol. Survey Circ. 355, p. 21, pl. 1, figs. 18-20, 22; THOMPSON & GOEBEL, 1963, Kansas Geol. Survey Bull., 165, p. 11-13.

Material studied.—169 specimens from this study. An additional 297 specimens too fragmental for specific reference were studied, and because only one species of Taphrognathus has been recognized, all or nearly all these specimens probably represent T. varians.

Repository.—Illinois State Geological Survey 23P39-23P41 (figured specimens).

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Illinois State Geological Survey Circular 388
26 p., 1 pl., 2 text-figs., 1 table, 1 distrib. chart, June 1965

Printed by Authority of State of Illinois, Ch. 127, IRS, Par. 58.25.

CIRCULAR 388

ILLINOIS STATE GEOLOGICAL SURVEY

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